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Temperature-Controlled Fluidic Device: A Concept

A symmetrical fluidic device has been conceived that may provide an improved method for directly converting electrical signals to mechanical signals in the form of a fluid-flow parameter (pressure, thrust, flow rate, etc). The device would have advantages over conventional fluidic amplifiers in that: 1) greater efficiency would result because all fluid would be used in the power jets; 2) there would be less danger of malfunction due to clogging, since no small-diameter control ports would exist; and 3) higher gain would be produced, because heat would be used only to deflect the jets, rather than to change momentum or pressure.

The jet deflector could be applied wherever there must be a good, reliable interface between electronic and fluidic systems. Such situations exist, for example, where the requirement for fast, complex logic necessitates the use of an electronic controller, but the final output must be mechanical in nature, or where input signals are electrical (or thermal) by nature, but advantages can be gained by fluidic signal processing.

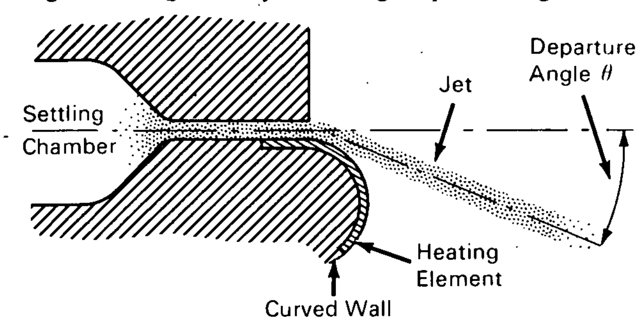

Figure 1. Jet Deflection by the Coanda Effect

Figure 1 illustrates the basic operating principle of the device, known as the Coanda effect. Essentially, the effect describes the deflection of a fluid jet caused by its adherence to a curved wall at an asymmetric nozzle. The figure shows the intuitive deflection, for a subsonic jet. In the case of a supersonic jet, however, the deflection actually occurs in a direction away from the curved wall.

Many parameters affect the magnitude of the departure angle θ. Among them are: 1) the nozzle geometry; 2) the Reynolds number and Mach number of the jet; 3) the ratio of nozzle exit pressure to the static pressure in the space outside the nozzle; and 4) the ratio of the temperature of the curved wall to the jet stagnation temperature. Of these, the wall temperature is the easiest to control, with, for instance, an electric heating element or Peltier-effect device.

The concept described here, and illustrated in Figure 2, is intended to eliminate or reduce the effects of all the undesirable parameters on the departure angle, leaving it essentially a function only of the controlled wall and jet temperatures. This is done by arranging

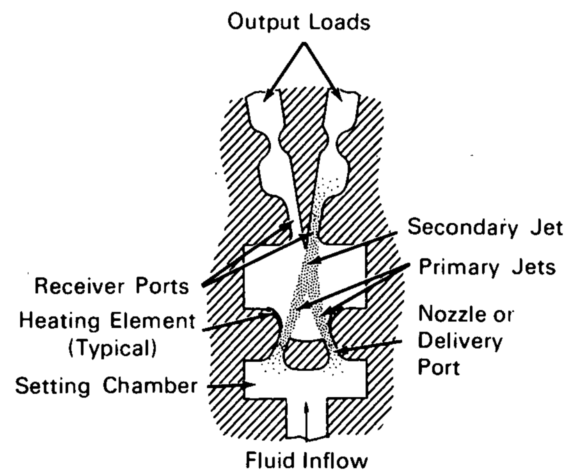

Figure 2. Temperature-Controlled Fluidic Device

(continued overleaf)

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two (or more) identical nozzles to produce a symmetrical array of primary jets, which merge at some distance downstream from the nozzles to form a single, secondary jet. Downstream from the merging point, the device behaves like a conventional fluidic amplifier. In the area of the primary jets, however, the direction of each jet is controlled by varying the temperature of the curved wall at the nozzle.

Notes:

1. This innovation is in the conceptual stage only; neither a model nor a prototype has been constructed as of the date of this Tech Brief.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   Headquarters
   National Aeronautics
   and Space Administration
   Washington, D.C. 20546
   Reference: TSP70-10167

Patent status:

No patent action is contemplated by NASA.

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